

Business white paper

HP Workstations and ANSYS

Running ANSYS Mechanical, Fluent and CFX



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Introduction

The purpose of this document is to provide information that will aid in selection of HP Workstations for running ANSYS Mechanical, Fluent and CFX. An ANSYS 14.5 performance study was completed on the ANSYS 14.0 benchmarks. Detailed results are provided for the HP Z820 Workstation running Windows 7 Professional 64-bit¹. Results are also provided with use of the NVIDIA Tesla K20 and C2075 on ANSYS Mechanical benchmarks. Recommended configurations are provided for the HP Workstations HP Z420, HP Z620 and HP Z820. Tips are also provided for running the solutions at ultimate performance.

The HP Z820 workstation speedup compared to the previous generation is significant.

The HP Z820 ANSYS 14.5 Mechanical DMP results were better than 14.0 results.

The HP Z820 workstation results for ANSYS 14.5 Mechanical DMP are presented on 2 core, 8 core and 16 core runs.

The HP Z820 results for ANSYS 14.5 Mechanical DMP with NVIDIA Tesla K20 were better than NVIDIA Tesla C2075 .

The HP Z420, HP Z620 and HP Z820 workstations can be configured with sufficient memory and NVIDIA Tesla K20² for ANSYS 14.5 Mechanical.

What type of application is ANSYS Mechanical?

ANSYS Mechanical is used for mechanical and structural engineering analysis/simulation.

The solution is used to compute the response of a structural system. The equation solvers that are used to drive the simulation are computational intensive. The equation solvers run on central processing unit (CPU) core(s) and in addition can run on graphics processing unit(s) (GPU). The GPU hardware is parallel computer architecture. The CPU core(s) will continue to be used for all other computations in and around the equation solver when GPU hardware is used. The large arrays of equation solvers and datasets used in the simulation require a large, fast memory system. The data storage files accessed during simulation benefit from dedicated, fast storage I/O systems. Use as much memory as possible to minimize the I/O required. The application has the ability to use parallel computing (both shared memory and distributed memory). The distributed memory model can run on a single machine or across machines/nodes (cluster) connected via high speed interconnect.

What type of application is ANSYS Fluent?

ANSYS Fluent is used for fluid flow design engineering analysis. The solvers are computational intensive and require a moderate size, fast memory system. The application has the ability to use parallel computing and can run on a single machine or across machines/nodes (cluster) connected via high speed interconnect.

What type of application is ANSYS CFX?

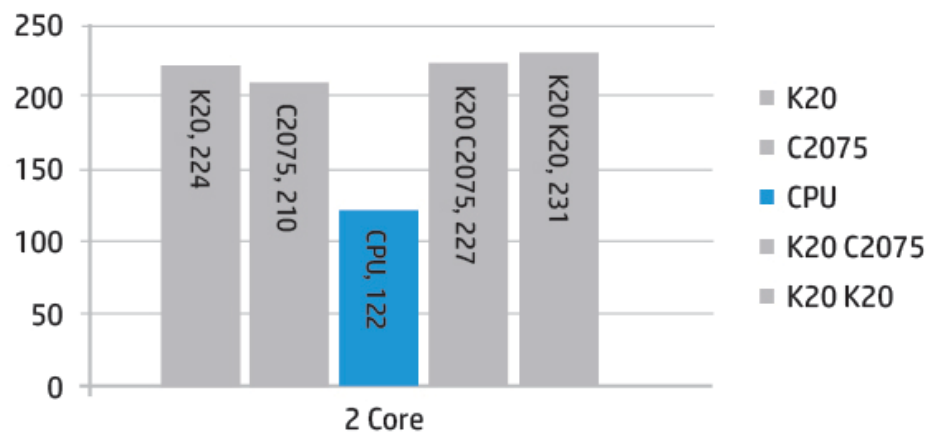
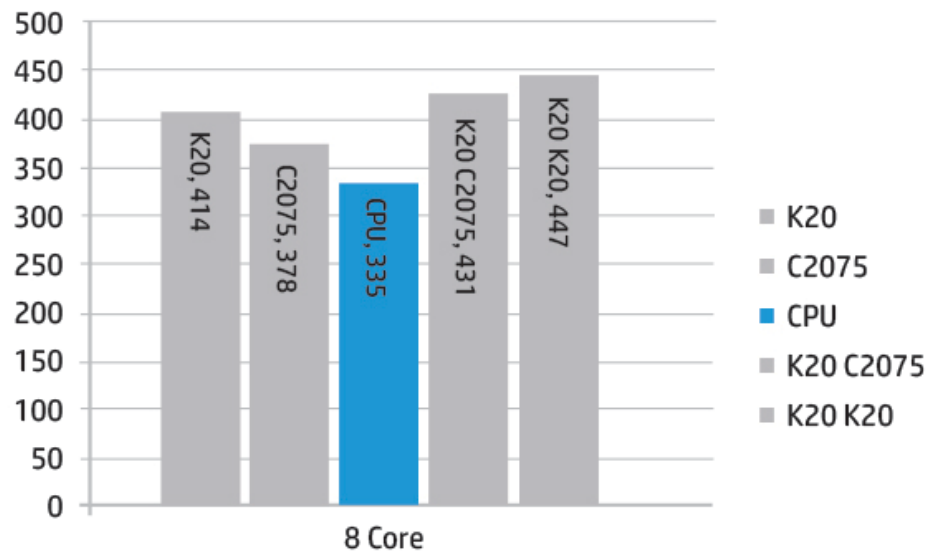
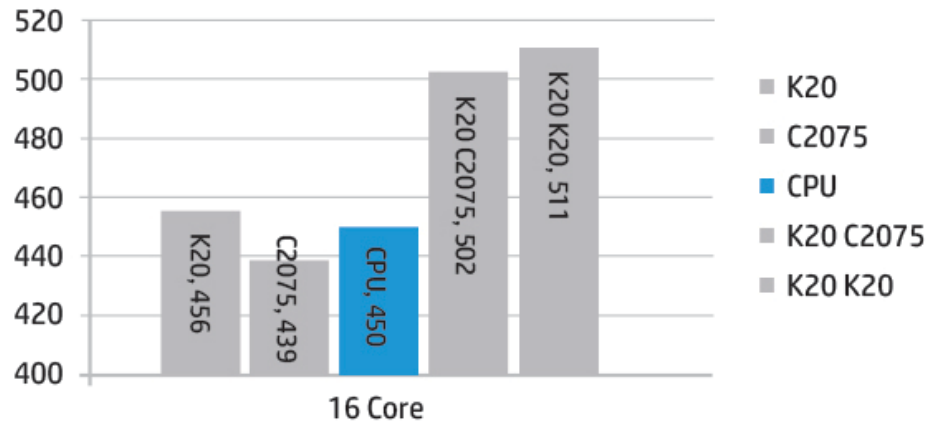
ANSYS CFX is used for general-purpose computational fluid dynamics (CFD). The solvers are computational intensive and require a moderate size, fast memory system. The application has the ability to use local parallel computing or distribute parallel computing across multiple machines/nodes connected via high speed interconnect.

How does the HP Workstation family (HP Z420, HP Z620 and HP Z820) provide outstanding ANSYS performance?

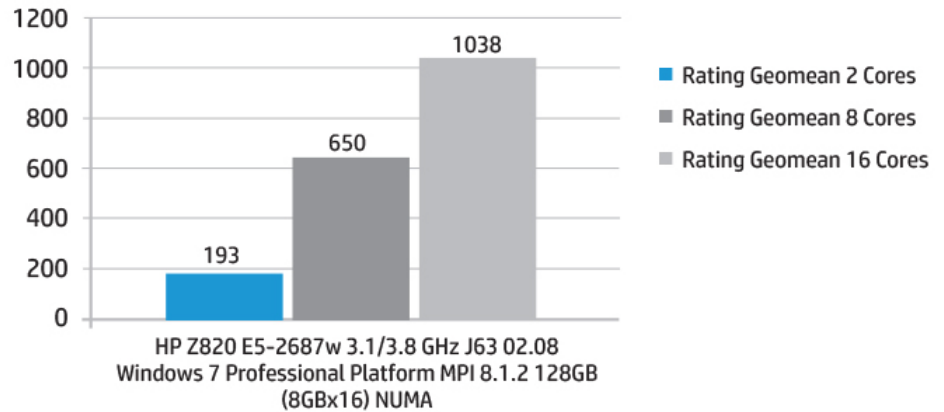
- **Compute** performance
 - Intel® AVX is a new 256 bit instruction set extension to SSE and is designed for applications that are Floating Point (FP) intensive. It was released early 2011 as part of the Intel® Xeon® E5-XXXX processor family. ANSYS 14.5 was compiled to utilize Intel® AVX.
 - HP Z420, HP Z620 and HP Z820 workstations utilize the Intel® Xeon® processor E5-XXXX family and the Intel® C602 chipset.
- **Memory** bandwidth and latency. The HP Z620 and HP Z820 have Dual QPI links in parallel with up to 8GT/s.
- **Memory** speed 1600MHz
- **Memory** design with either 2 or 4 channels per processor
 - HP Z420 supports unbuffered DIMMs (UDIMM)
 - 8 DIMM sockets, 4 channels, 2 DIMMs per channel
 - HP Z620 supports unbuffered DIMMS (UDIMM) and registered DIMMS (RDIMM)
 - 12 DIMM sockets, 4 channels
 - 2 DIMMs per channel - CPU0 – 8 sockets
 - 1 DIMM per channel - CPU1 – 4 sockets
 - HP Z820 supports unbuffered DIMMs (UDIMM), registered DIMMS (RDIMM) and load-reduced DIMMS 1333MHz (LRDIMM)
 - Mixing UDIMM / RDIMM / LRDIMM is not permitted
 - 16 DIMM sockets, 4 channels
 - 2 DIMMS per channel – CPU0 – 8 sockets
 - 2 DIMMS per channel – CPU1 – 8 sockets
- **Storage I/O** performance
 - PCI-Express 3.0
 - 6 Gb/s SATA and SAS ports
 - DMA bandwidth
 - 6 Gb/s hard drives (HDD) and 6 Gb/s solid state drives (SSD)
 - Storage volumes can be configured with RAID 0 for speed and RAID 1 for resilience
 - USB 3.0 ports
- **GPU Compute** acceleration
 - NVIDIA Tesla K20 is a supported option in the HP Z420, HP Z620 and HP Z820² Workstations.

HP Workstations and ANSYS Performance Benchmarks

What ANSYS 14.5 Mechanical DMP performance did HP measure on the HP Z820 workstation?



What ANSYS 14.5 Fluent performance did HP measure on the HP Z820 workstation?



HP Workstation recommendations and tips for running ANSYS 14.0 and 14.5 Mechanical

DMP Simulation up to 64GB, 8-Core, Tesla

- HP Z420 Intel® Xeon® E5-2687w 8-Core 3.1/3.8 tb, 64GB memory, 512GB SATA SSD, NVIDIA Tesla K20, NVIDIA Quadro K600

DMP Simulation up to 96GB, 16-Core, Tesla

- HP Z620 2x Intel® Xeon® E5-2690 8-Core 2.9/3.8tb, 96GB memory, 512GB SATA SSD, NVIDIA Tesla K20, NVIDIA Quadro K2000

DMP Simulation up to 512GB, 16-Core, Tesla

- Z820 2x Intel® Xeon® E5-2690 8-Core 2.9.3.8tb, 128GB memory, 512GB SATA SSD, NVIDIA Tesla K20, NVIDIA Quadro K2000

SMP Simulation

- Similar configurations as DMP above. Although the NVIDIA Tesla is not recommended for SMP.

Memory sizing is critical. Use as much memory as possible to minimize the I/O required.

Windows 7 64-bit Professional Service Pack 1

Windows 7 64-bit Professional uses physical memory for dynamic buffer cache when available. The buffer cache prevents disk I/O transactions. Memory is much faster than disk I/O. Additional memory for the OS is necessary.

Storage

- HP workstations have 6 Gb/s and 3 Gb/s disk I/O ports. The 6 Gb/s I/O ports are recommended for 6 Gb/s devices.
- 3 Gb/s devices will negotiate 3 Gb/s protocol when plugged into 6 Gb/s ports.
- Simulations that do not fit in physical memory will benefit from a RAID 0 storage volume configuration for performance. A RAID 1 storage volume configuration will provide resilience.
 - 2-3x 6 Gb/s SSD RAID 0
 - 3-4x 6 Gb/s HDD RAID 0

Tips for running ANSYS 14.0 and 14.5 Mechanical

Read the ANSYS Mechanical APDL Parallel Processing Guide—

- Chapter 2: Using Shared Memory ANSYS
- Chapter 3: GPU Accelerator Capability
- Chapter 4: Using Distributed ANSYS

Operating System Setting	Default	Recommend
Windows 7 Professional 64-bit ¹		Service Pack 1
Control Panel/Power Options	Balanced	High Performance

BIOS Setting	Default	Recommend
Power/OS Power Management/Runtime Power Management	Enable	Enable
Power/OS Power Management/Idle Power Savings	Extended	Normal
Power/OS Power Management/Turbo Mode ⁸	Enable	Enable
Advanced/Device Options/Hyper-Threading ⁹	Enable	Disable
Advanced/Bus Options/NUMA (HP Z620 and HP Z820 Dual processor)	Enable	Disable

NVIDIA Tesla K20 GPU Accelerator Setting	Default	Recommend
ECC Mode	Enable	Enable
Driver Model	TCC Mode	TCC Mode
Driver Version		276.28 and up

There is a Device state management tool that can be used to manage NVIDIA Tesla settings:

%SystemDrive%\Program Files\NVIDIA Corporation\NVSMI\nvidia-smi.exe

ANSYS 14.0 DMP, only a single GPU accelerator device can be utilized during solution.

ANSYS 14.5 DMP, two GPU accelerator devices per machine can be utilized during solution.

On machines containing multiple GPU accelerator devices, the ANSYS program will pick the first available GPU accelerator device that is supported.

Conditions that will cause GPU not to be used:

- Partial pivoting is activated when using the sparse solver
- Memory saving option is activated (MSAVE,ON) when using the PCG solver
- A non-supported equation solver is used
- On Windows OS, the use of Remote Desktop may disable the use of a GPU device when in driver model is WDDM mode.

HP Workstations Recommendations and Tips for running ANSYS 14.0 and 14.5 Fluent or CFX

Fluent and CFX Analysis up to 64GB, 8-Core

- HP Z420 Intel® Xeon® E5-2687w 8-Core 3.1/3.8 tb, 64GB memory, 512GB SATA SSD, NVIDIA Quadro K600

Fluent and CFX Analysis up to 96GB, 16-Core

- HP Z620 2x Intel® Xeon® E5-2690 8-Core 2.9/3.8tb, 96GB memory, 512GB SATA SSD, NVIDIA Quadro K2000

Fluent and CFX Analysis up to 512GB, 16-Core

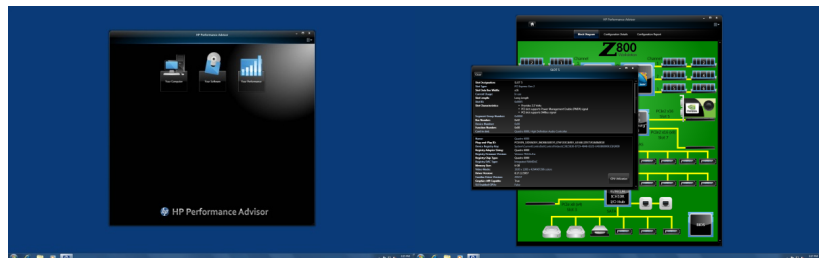
- HP Z820 2x Intel® Xeon® E5-2690 8-Core 2.9.3.8tb, 128GB memory, 512GB SATA SSD, NVIDIA Quadro K2000

Tips for running ANSYS 14.0 and 14.5 Fluent or CFX

Operating System Setting	Default	Recommend
Windows 7 Professional 64-bit ¹		Service Pack 1
Control Panel/Power Options	Balanced	High Performance

System Bios Setting	Default	Recommend
Power/OS Power Management/ Runtime Power Management	Enable	Enable
Power/OS Power Management/Idle Power Savings	Extended	Normal
Power/OS Power Management/Turbo Mode ⁸	Enable	Enable
Advanced/Device Options/Hyper-Threading ⁹	Enable	Disable
Advanced/Bus Options/NUMA (HP Z620 and HP Z820 Dual processor)	Enable	Enable

HP Performance Advisor can be used to install graphics drivers, select BIOS settings and help characterize ANSYS memory usage. Download from hp.com/go/hpperformanceadvisor



Notes

- 1 Multi-Core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. 64-bit computing on Intel® architecture requires a computer system with a processor, chipset, BIOS, operating system, device drivers, and applications enabled for Intel® 64 architecture. Processors will not operate (including 32-bit operation) without an Intel® 64 architecture-enabled BIOS. Performance will vary depending on your hardware and software configurations.
- 2 NVIDIA Tesla K20 and C2075 on the HP Z820 requires the 1125W power supply.
- 3 SATA hardware RAID is not supported on Linux systems. The Linux kernel, with built-in software RAID, provides excellent functionality and performance. It is a good alternative to hardware-based RAID. Please visit hp.com/bc/docs/support/SupportManual/c00060684/c00060684.pdf for RAID capabilities with Linux. HP Z200 does not support RAID 10 Because of drive bay limitation.
- 4 For hard drives, 1 GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 20 GB of hard drive (or system disk) is reserved for system recovery software for Windows 7.
- 5 Multi-Core technologies are designed to improve performance of multithreaded software products and hardware-aware multitasking operating systems and may require appropriate operating system software for full benefits. Not all customers or software applications will necessarily benefit from use of these technologies.
- 6 Each processor supports up to 2 channels (HP Z220 CMT/HP Z220 SFF) or 4 channels (HP Z420/HP Z620/HP Z820) of DDR3 memory. To realize full performance at least 1 DIMM must be inserted into each channel. To get full 8 channel support, 2 processors MUST be installed.
- 7 AMD Graphics are not supported when there are greater than 32 GB of system memory present.
- 8 Intel® Turbo Boost technology requires a PC with a processor with Intel Turbo Boost capability. Intel Turbo Boost performance varies depending on hardware, software and overall system configuration. See intel.com/technology/turboboost for more information.
- 9 Intel HT Technology (HT) is designed to improve performance of multi-threaded software products and requires a computer system with a processor supporting HT and an HT-enabled chipset, BIOS and operating system. Please contact your software provider to determine compatibility. Not all customers or software applications will benefit from the use of HT. See intel.com/info/hyperthreading for more information.

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