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White Paper | OPTIMIZING AMD RYZEN™
THREADRIPPER™ PRO PROCESSORS
FOR OPTIMAL PERFORMANCE WITH
ANSYS SIMULATION SOFTWARE

INTRODUCTION

Lenovo has partnered with AMD to create the world's first AMD Ryzen™ Threadripper™ PRO-powered workstation: the ThinkStation P620. Delivering dual-CPU performance in a single-processor workstation, the P620 is performance-tuned and ISV certified for multithreaded application environments. With up to 64 cores, 128 PCIe lanes (Gen 4), up to 1TB of memory, and an 8-channel memory architecture, designers and engineers have access to datacenter-like power on their desktop in a compact and economical package. Backed by enterprise-level features for seamless security, manageability, and support, the ThinkStation P620 is an ideal solution for enterprises and SMBs creating mission critical simulations. Ansys® develops some of the most widely used multiphysics engineering simulation software solutions for product design, testing, and operation. With the ThinkStation P620, designers and engineers can run complex simulations on the desktop earlier in the design process to test and validate design ideas without tying up valuable data center resources.

THE PURPOSE OF THIS WHITEPAPER IS TWOFOLD:

1. To illustrate how Ansys® Fluent® computational fluid dynamics (CFD) software solutions scale on the ThinkStation P620 family when the standard benchmarks are tested with 32 core and 64 core Threadripper PRO processors.

2. To demonstrate how various optimization methods impact the performance of these Ansys Fluent software solutions on the ThinkStation P620 family.

SUMMARY

AMD and Lenovo partnered with the consulting firm MVConcept (https://mvconceptlab.com) to assess the performance of Ansys® Fluent on the latest workstation processors. Fluent is a versatile computational fluid dynamics (CFD) tool that includes well validated physical modeling capabilities to deliver fast, accurate results across a broad range of CFD and multiphysics applications. It is widely used in automotive, aerospace, academia, oil & gas, marine and Formula 1 racing. Typical workload sizes range from two million to 500 million cells. This study analyzes the performance of Ansys Fluent software as measured with fourteen common benchmark workloads provided by Ansys.

Real world workloads vary in size and complexity and there are additional BIOS, software, and OS variables that impact performance beyond the CPU. Therefore this summary focuses on a high-level overview of relative CPU performance. End users should contact their AMD and Lenovo technical representatives for additional guidance on performance optimization when running Ansys Fluent on the AMD Ryzen™ Threadripper™ PRO processor that powers the Lenovo ThinkStation P620.

KEY TAKEAWAYS:

• A Lenovo ThinkStation P620 with an AMD Ryzen Threadripper PRO 5975WX processor running (fourteen) Ansys Fluent benchmarks[1] has higher performance on Linux than on identically configured hardware running Windows.

• The Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5995WX utilizing all 64 cores delivers the highest absolute performance for Fluent users relative to other machines tested.

• When Ansys Fluent is licensed for 32 cores, the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5995WX delivers the highest performance of the tested solutions.

TESTING PROCESS:

Testing was conducted by performance consulting firm MVConcept. MVConcept ran the benchmarks on the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 3975WX, 5975WX, and 5995WX, as well as on a similarly configured BOXX system with an Intel® Xeon® W-3365 processor. The benchmarks were run multiple times in an exhaustive combination of Ansys Fluent versions (2020R1 and 2022R1), BIOS settings, core counts, tuned launch settings, optimized math libraries, optimized MPI libraries, and applying MVConcept-defined affinity masks for enhanced thread pinning[2]. All test combinations were run on both Windows 10 Professional (x64) Build 19044.1706 (21H2) and CentOS Linux release 8.4.2105, resulting in a total of 3452 unique test runs. The Lenovo recommended BIOS settings leverage the testing that was reported in *"Optimizing Ansys performance on the Lenovo ThinkStation P620"*, available from https://www.ansys.com/content/dam/company/technology-and-solution-partners/workstation-p620-ansys-white-paper.pdf. The largest representative tests (including f1_racecar_140m) were run a minimum of three times with less than 1% variability among the repeated test runs. The following chart summarizes the impact of the performance gained by the Lenovo optimized BIOS settings (SMT=OFF, NPS=4) and the additional performance realized by MVConcept's additional optimization methods.

[1] *aircraft_wing_14m, aircraft_wing_2m, combustor_12m, combustor_71m, exhaust_system_33m, f1_racecar-140m, fluidized_bed_2m, ice_2m, landing_gear_15m, lm6000_16m, oil_rig_7m, pump_2m, rotor_3m, sedan_4m*

[2] *An optimized processor affinity mask considers the shared access to L3 cache and minimizes core to core latency in a manner that results in better application performance with higher numbers of CPU cores deployed. MVConcept created the affinity masks used in this study and they continue to further enhance their recommended affinity masks.*

f1_racecar_140m performance with Ansys Fluent 2022 R1 on Threadripper PRO 5995WX, CentOS 8.4 *(higher is better)*

BIOS AND LAUNCH MODE CONFIGURATION
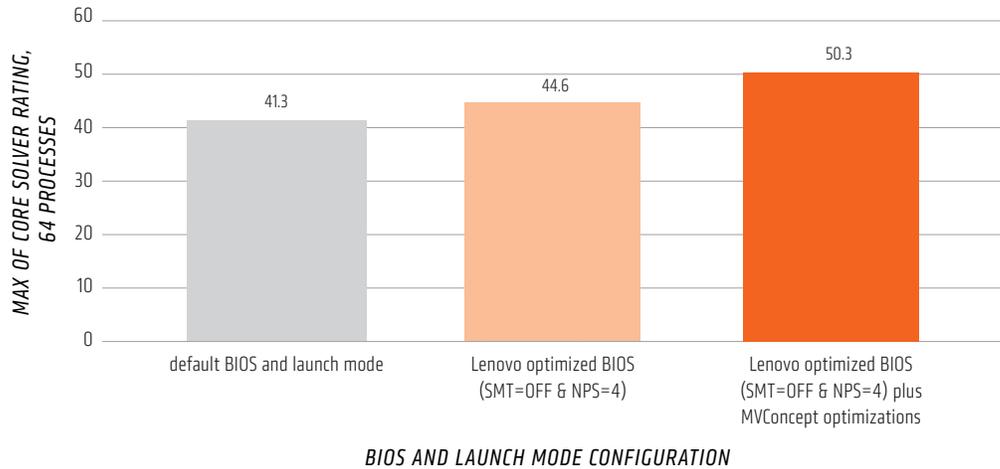
The performance impact of the Lenovo optimized BIOS and the Lenovo optimized BIOS plus the MVConcept optimizations varies based on the size and complexity of the workload. In this case the f1_racecar_140M workload is shown because it is the largest of Ansys Fluent benchmark workloads and therefore representative of larger end user workloads. End users with intensive performance challenges can consult with MVConcept to obtain the most current performance tuning recommendations for their specific workload requirements.

Performance Highlight #1: Operating System

Running the fourteen Ansys Fluent benchmarks on the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5975WX on Windows 10 requires up to 21% more time than running the same benchmarks under CentOS 8.4 Linux on the identical 5975WX hardware:

Aggregate performance of Ansys Fluent 2022 R1 on identical 5975WX hardware based on 14 standard benchmarks *(lower is better)*
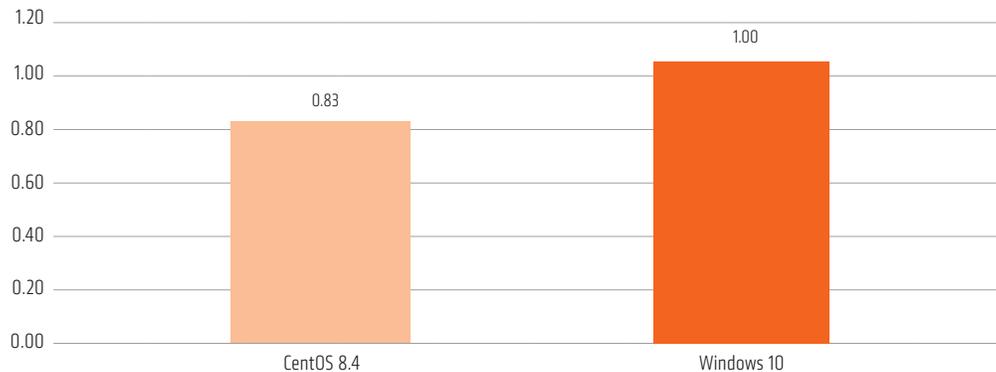
FIGURE 1: ANSYS FLUENT 2022R1, THREADRIPPER PRO 5975WX, DEFAULT BIOS, 32 PROCESSES

Performance Highlight #2: Number of CPU cores

When Ansys Fluent is licensed to use all available cores, the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5995WX utilizing all 64 cores delivers the highest absolute performance for Fluent users relative to other (32 core) workstations tested:

Aggregate runtime performance of Ansys Fluent 2022 R1 running on all available cores and based on 14 standard benchmarks (*lower is better*)
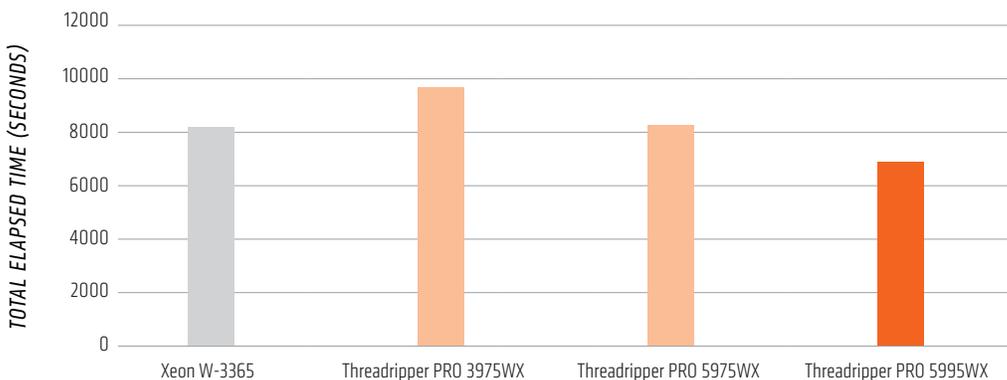
FIGURE 2: ALL AVAILABLE CORES PER CPU, CentOS 8.4

Performance Highlight #3: Size of L3 cache

When licensing of Ansys Fluent is constrained to 32 processes (with an affinity mask to evenly distribute worker threads by L3 cache domain), once again the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5995WX delivers the highest performance for Fluent users. This is attributable to the larger (256MB) L3 cache offered on the 5995WX versus the 128MB L3 cache offered on the 5975WX. The performance delta varies with the specific workload as indicated in the charts below, with larger workloads consistently running ~8% faster.

Relative core solver rating for Ansys Fluent 2022 R1 on 32 processes, 5975WX vs 5995WX (*higher is better*)
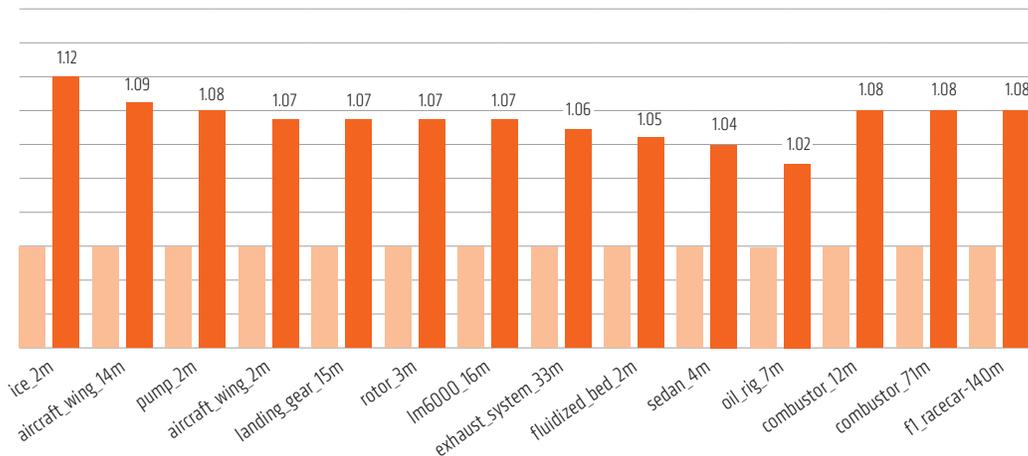
FIGURE 4: CentOS 8.4, TUNED BIOS

Threadripper™ PRO 5995WX running 32 processes
Threadripper™ PRO 5975WX running 32 processes

CONCLUSION:

AMD and Ansys maintain ongoing technical engagements that strive to improve the performance of Ansys software on AMD hardware. The analysis shared above reveals that performance of Ansys Fluent on AMD Ryzen Threadripper PRO processors is impacted by a variety of variables including operating system, BIOS settings, launch mode, core count, and L3 cache size. Whether running 32 processes or 64 processes of Ansys Fluent, the Lenovo ThinkStation P620 with AMD Ryzen Threadripper PRO 5995WX delivers the best overall performance in representative tests among the systems tested.

As demonstrated through exhaustive testing of the Lenovo ThinkStation P620, AMD Ryzen Threadripper PRO 5000 WX-Series processors deliver datacenter-like performance to designers and engineers in a compact and economical desktop package. The value proposition for Threadripper PRO 5000WX is further enhanced by the system optimizations and application settings that MVConcept has developed through their optimized affinity masks and other tuning methods. Contact your AMD or Lenovo technical representative for the latest updates and advice for extracting the maximum performance for specific end user workloads when using the Lenovo ThinkStation P620 and the AMD Ryzen Threadripper PRO 5000 WX-Series processors.

Test system configurations

	AMD 32 CORE (SYSTEM 1)	AMD 32 CORE (SYSTEM 2)	INTEL 32 CORE	AMD 64 CORE	AMD 64 CORE
CPU	Threadripper PRO 5975WX	Threadripper PRO 5975WX	Xeon W-3365	Threadripper PRO 5995WX	Threadripper PRO 3995WX
MEMORY	512GB DDR4 3200	512GB DDR4 3200	512GB DDR4 3200	1TB DDR4 3200	1TB DDR4 3200
STORAGE	INTEL SSDPED1D015TAY 1.5TB	INTEL SSDPED1D960GAY 960GB	SAMSUNG MZ1L21T9HCLS-00A07 1.920TB	SAMSUNG MZVL21T0HCLR-00BL7 1TB	INTEL SSDPED1D015TAY 1.5TB
OS	CentOS Linux 8.4.2105 Microsoft Windows 10 Enterprise LTSC	CentOS Linux 8.4.2105 Microsoft Windows 10 Enterprise LTSC	CentOS Linux 8.4.2105 Microsoft Windows 10 Enterprise LTSC	CentOS Linux 8.4.2105 Microsoft Windows 10 Enterprise LTSC	CentOS Linux 8.4.2105 Microsoft Windows 10 Enterprise LTSC
ANSYS VERSION	2022 R1	2022 R1	2022 R1	2022 R1	2022 R1

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