

*FIGURE 1: PHONE WITH TWO INTEGRATED 5G MMWAVE (28GHZ) 4-ELEMENT DUAL POLARIZED MODULES.  
FAR FIELD PLOTS OVERLAID ON MODULES.*

White Paper | **AMD OPTIMIZED CPU LIBRARIES (AOCL)  
ON AMD RYZEN™ THREADRIPPER™ PRO  
PROCESSORS ENABLE SIGNIFICANT  
PERFORMANCE UPLIFT WITH  
ANSYS® HFSS®**

This white paper is a technical explanation of what the discussed technology has been designed to accomplish. The actual technology or feature(s) in the resultant products may differ or may not meet these aspirations. Each description of the technology must be interpreted as a goal that AMD strived to achieve and not interpreted to mean that any such performance is guaranteed to be fully achieved. Any computer system has risks of security vulnerabilities that cannot be completely prevented or mitigated.

Lenovo has collaborated with AMD to create the world's first AMD Ryzen™ Threadripper™ PRO processor-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 sophisticated power on their desktop, in a compact and economical package. Backed by enterprise-level features for seamless security features, 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.

Ansys HFSS is a 3D electromagnetic (EM) simulation software for designing and simulating high-frequency | electronic products such as antennas, antenna arrays, RF or microwave components, high-speed interconnects, filters, connectors, IC packages and printed circuit boards. Engineers worldwide use Ansys HFSS software to design high-frequency, high-speed electronics found in communications systems, advanced driver assistance systems (ADAS), satellites, and internet-of-things (IoT) products.

HFSS makes heavy use of BLAS and LAPACK linear algebra libraries to complete the simulation computations and has historically integrated Intel MKL into HFSS to accelerate the simulation workload. In HFSS 2022 R1 Ansys integrated the AMD Optimizing CPU Libraries (AOCL) into HFSS as a user selectable beta feature and released in an automated implementation at HFSS 2023 R1. This paper leverages extensive testing completed by the consulting firm MVConcept (<https://mvconceptlab.com>) to assess the performance impact of choosing AOCL versus the default Intel MKL when running HFSS on the Lenovo ThinkStation P620 with Threadripper PRO 5000WX.

## Ansyes HFSS Test Methodology:

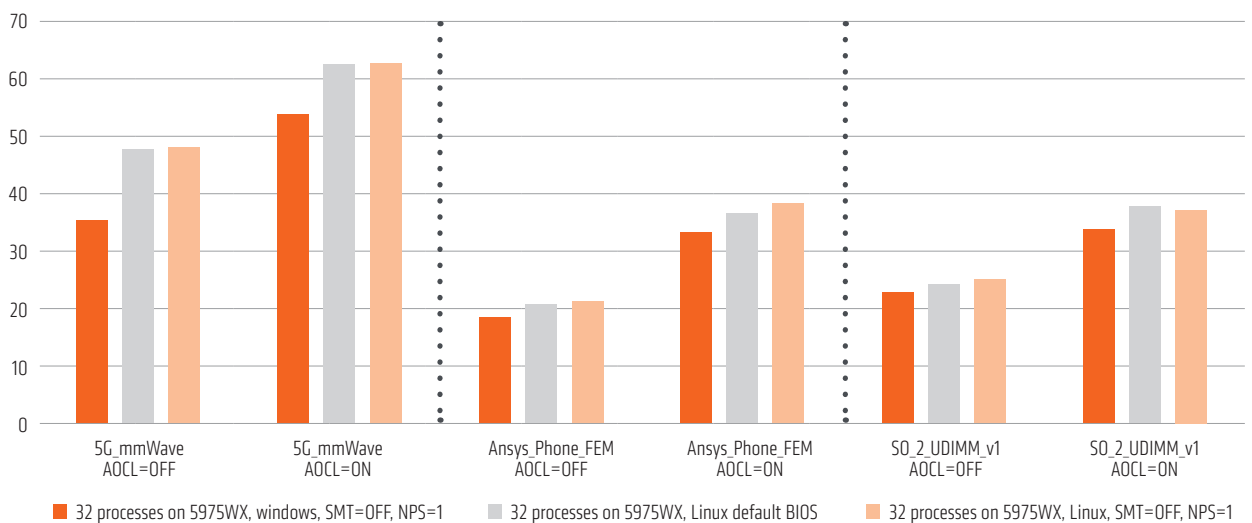
MVConcept began the analysis by testing the various combinations of BIOS settings of the Lenovo ThinkStation P620 to determine which BIOS settings yielded the highest performance results. The optimal BIOS settings vary from application to application, and in the case of HFSS the highest performance is attained on a Threadripper PRO processor with:

- SMT (Symmetric Multithreading)=OFF
- NPS (NUMA per socket) = 1

There were three HFSS designs tested. For these tests only the timing of the last adaptive pass was studied to isolate to the greatest degree possible the impact of processor and library performance on simulation time. One was a detailed model of a mobile phone (Fig. 1) operating in the 28 GHz 5G mmWave band with 20 ports associated with antenna and PCB terminals. Simulation problem size metrics are first order matrix solve, a tetrahedral mesh count of 2,993,067, matrix size of 19,017,448, and matrix bandwidth of 21.9. The second was a 5GHz solve of an SO-DIMM module with eight packages and 128 ports and simulation size metrics of a 0.572515 mixed order solve, with a tetrahedral mesh count of 6,349,159, matrix size of 29,060,473, and matrix bandwidth of 19.8. The final was a 5G 28GHz mmWave array antenna solved using the domain decomposition solver method and 3D Component array flow and simulation size metrics of a first order solve, with a tetrahedral mesh count of 2,576,320, matrix size of 17,445,772, and matrix bandwidth of 274.

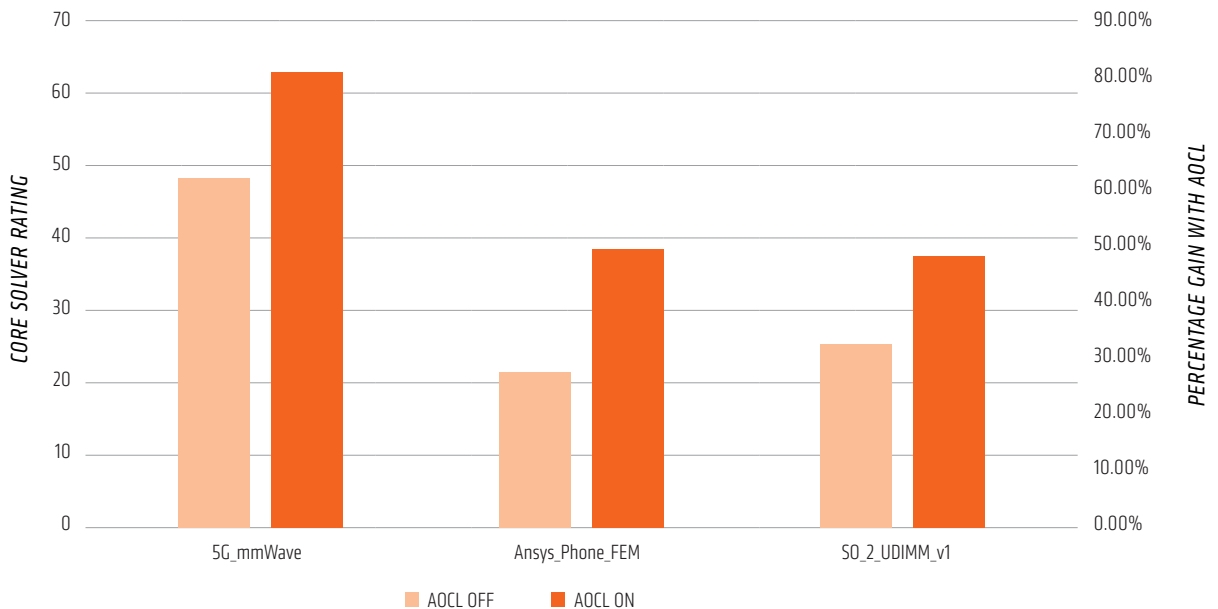
MVConcept also evaluated the performance of Ansys HFSS when running on Windows 10 versus CentOS Linux 8.4 on the identical hardware configuration and ran all the standard Ansys HFSS benchmark workloads with AOCL enabled and without AOCL enabled (which defaults to Intel MKL). Finally, testing was completed on the Lenovo ThinkStation P620 with the Threadripper PRO 5975WX (32 core) and the 5995WX (64 core) processors. When examining the performance of the last adaptive pass across all measured variables, the highest performance is achieved on the Threadripper PRO 5975WX processor with optimized BIOS (SMT=OFF, NPS=1), Linux, and the AOCL math libraries selected. The overview of these variables as measured on the Threadripper PRO 5975WX processor are represented in this chart:

Impact of OS, BIOS, and math libraries on performance of Ansys HFSS 2022 R1 - Core Solver Rating (*higher is better*)



The most significant variable impacting performance comes from selecting AOCL when running Ansys HFSS on Zen-based platforms like the Threadripper PRO 5000WX Series processors. This chart provides a clear view of the impact of enabling AOCL versus the use of the default math libraries across all three of the standard Ansys HFSS benchmark workloads an average of 52% performance gain with AOCL:

Impact of AOCL math libraries on performance of Ansys HFSS 2022 R1 - Core Solver Rating (*higher is better*)



**CONCLUSION:**

AMD is continuously working with ecosystem partners to improve the performance and efficiency of key industry software workloads on AMD-based systems like the Lenovo ThinkStation P620 featuring AMD Ryzen Threadripper PRO 5000WX processor. AMD collaborated with Ansys to integrate AOCL into Ansys HFSS 2022 R1 and 2022 R2 as a user selectable option, which enabled MVConcept to measure the direct impact of AOCL on and off when running identical hardware and software configurations. The performance gains delivered by integrating AOCL into Ansys HFSS proved to be so impactful that AOCL is automatically invoked on Ansys HFSS 2023 R1 and higher when Zen-based platforms are detected. The integration of AOCL into Ansys HFSS 2022 R1 (and higher) enables end users to realize the full potential of the powerful Lenovo ThinkStation 620 featuring AMD Ryzen Threadripper PRO 5000WX processor and delivers an excellent showcase of the value of ongoing software tuning and optimization.

**AMD Optimizing CPU Libraries (AOCL)**

AOCL is a set of numerical libraries specifically tuned and optimized for AMD Ryzen™, AMD Ryzen™ Threadripper™ PRO, and AMD EPYC™ processors. The Windows and Linux libraries conform to industry standards and are straightforward to integrate into applications. More information about AOCL is available at <https://www.amd.com/en/developer/aocl.html>

## System configuration details

	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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