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Q&A

Peak Computing Power and Performance

AMD's "Zen" Core architecture meets the challenges of modern engineering workflows

AMD | DE247 Digital Engineering

Design engineers have seen their workflows evolve to include more rapid design iterations, more frequent use of simulation, more complex modeling, and more rapid visualization and rendering. As a result, there has been demand for more powerful engineering workstations and compute resources, and the AMD "Zen" core architecture has been a key component in enabling these workflows. Introduced in 2017, the powerful and energy efficient platform can scale from laptops to servers. The "Zen" core-based Ryzen™ Threadripper™ PRO family of CPUs has emerged as an industry leading compute platform, offering the largest core counts available – and providing the performance required for emerging engineering and visualization workflows.

CHRIS HALL, *Director of Software Performance Engineering, AMD*

Digital Engineering spoke to Chris Hall, Director of Software Performance Engineering at AMD about the development of the "Zen" core architecture, and how the latest AMD CPUs, like the recently announced AMD Ryzen™ Threadripper™ PRO 5000 WX-Series processors, continue to move the goalposts on CPU efficiency and performance.

Q: *What has been the guiding philosophy underpinning the development of the "Zen" Core architecture over the past several years?*

A: The word I would use is "balance". We have a balanced core design that is very efficient. We designed a core that is used in notebooks, deployed in desktops and workstations, and we needed the design to scale up and down through those different types of users. The core design has been optimized to deliver outstanding power performance as well as delivering amazing single-threaded performance.

Q: *What are the key advantages/differentiators of the architecture?*

A: Our chiplet design philosophy is a key advantage. With the "Zen" architecture, rather than design unique CPUs, when we want to increase the core count, we simply add more chiplets. That is what allows us to reuse the same core design, keep it power efficient and cost efficient, yet scale up to 128 PCI Express® lanes and 8 memory channels.

With chiplets, you have a package that includes a certain number of cores, and a certain amount of CPU cache that keeps the data close to the processor and keeps them running at a high efficiency. When you use multiple chiplets, as in the Ryzen™

Threadripper™ PRO CPUs, as you add more cores you are also adding more cache. That allows multi-threading to scale in a way that is only available in the Threadripper™ PRO processor line.

Q: *In the engineering space, we see the need for larger and more complex designs and models, along with more frequent simulation. How do the Ryzen™ Threadripper™ PRO processors address these applications, which have both single- and multi-threaded operations?*

A: In the past, it was possible to have high core count processors, but in those architectures, there was a trade-off between multi-threaded and single-threaded performance. Threadripper™ PRO processor has very high single-threaded performance. You are not sacrificing anything by choosing Threadripper™ PRO processors for your engineering applications.

On top of that, you can match the multi-threaded scalability of the platform to your applications. You can pick a core count that suits your budget and application needs. With Threadripper™ PRO processors you can choose from 12 cores all the way up to 64 cores – which is the highest core count you can get in a CPU today. In fact, in an engineering group you might standardize on the Threadripper™ PRO processor platform, but different users may have different core counts.

It's not just the core count that matters. The 64-core processors also have very large L3 cache. What we have found with some applications, especially some mechanical simulations, is that you may want to select a 64-core processor even though you are running 32-thread software. Each one of those 32 threads has access to double the L3 cache, which brings the data closer to the CPU cores resulting in higher performance for that 32-thread application.

Q: *Ansys® announced support for AMD's AOCL software library in their Ansys® Mechanical™ product in 2021. What is AOCL and how does it help engineering workflows?*

A: AOCL stands for AMD Optimizing Compute Libraries. Many engineering applications distill down to a lot of high-performance math, especially linear algebra, to perform calculations.

As part of AOCL we have BLIS, which is an accelerated implementation of a linear algebra library. What BLIS brings to the party for AMD users with applications like Ansys, who are the first adopter of AOCL and BLIS, is it brings the most optimal version of those linear algebra algorithms for the AMD platform.

Before AMD released AOCL, there were software packages available from other companies. Some of them did not have the performance characteristics that we were looking for in our processors, and we brought AOCL into the Windows and Linux markets to really ensure that our customers are getting all the performance that they paid for. For example, with ANSYS Mechanical we have seen up to 2.3x the performance after the AOCL integration[1].

Q: *How important is power efficiency for workstation users? How has AMD addressed power management and efficiency in the Threadripper™ PRO line?*

A: It is important for all PC users since electricity is not getting any cheaper. Whether you are a one-man shop or part of a large enterprise, the cost of your computer is not just the cost you pay upfront; the total cost of ownership includes monthly electricity bills, and the air conditioning you pay for in the summer because your computer might be pumping out a lot of heat. The "Zen" cores are designed to be as power efficient as possible. We have outstanding power efficiency.

A power-efficient CPU also allows you to have a more compact, space efficient workstation. On top of that, it is important, especially in the engineering space, to pair a high-powered processor like a Threadripper™ PRO processor with a very high-powered graphics card. Graphics cards deliver a lot of compute performance, but they also require a lot of power. A power efficient CPU like a Threadripper™ PRO processor means that a smaller workstation form factor and power supply can still accommodate a powerful graphics solution.

This benefit applies to mid-sized workstation towers too. Having a very power-efficient CPU also allows you to put multiple graphics cards in a workstation without having to resort to unusual power supply and delivery arrangements.

Q: *For design engineers evaluating the latest Threadripper™ PRO processors, what types of improvements and benefits can they expect?*

A: With our new AMD Ryzen™ Threadripper™ PRO 5000 WX Series processors, users will see a large increase in single-threaded performance over the previous generation[2], which already had very good single-threaded performance.

We have already delivered multi-threaded performance, and now more than ever we are ensuring that there is no compromise for single-threaded application functionality. Whether that single-threaded performance shows up in the speed with which you can rotate 3D models on your screen because the CPU is delivering the 3D model data to the GPU more quickly, or when you are performing tasks like part regeneration or assembly regeneration in your CAD program, which are largely single-threaded operations, those are the places where you will see a big jump in performance from the previous generation.

In addition, we continue to add state-of-the-art security features to our processors. That is something that is top-of-mind for a lot of customers, especially as the threat of cyber security incidents increases. The last thing you want is a workstation that is vulnerable to attack. By continuing to deliver features such as AMD Shadow Stack for the Threadripper™ PRO 5000 Series processors, we are continuing to help protect your workstations against threats.

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1 Based on AMD performance lab testing on January 27, 2021, using 64-core AMD Ryzen™ Threadripper™ PRO 3995WX. The workstation was populated with 1 DIMM per channel of 32GB, dual-rank, DDR4-3200 DIMMs, for a total of 512GB of memory per system. CPP-79

2 Based on AMD performance lab testing on January 31, 2022, using the SPECapc® for PTC Creo 3.0 CPU Composite metric to compare performance of AMD Ryzen™ Threadripper™ PRO 5000 WX-Series reference system configured with 8x32GB DDR4, NVIDIA Quadro RTX A5000, 1TB SSD, Win 11 vs. similarly configured reference workstations with AMD Ryzen™ Threadripper™ PRO 3000WX-Series processors. Results may vary. SPEC®, and SPECapc® are registered trademarks of the Standard Performance Evaluation Corporation. See www.spec.org for more information. CGP-34