



Computer Technologies

AMD Ryzen 4th Gen Threadripper CPU



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Introduction

AMD's Ryzen Threadripper 5000 processor series are CPUs for high-end desktops (HEDT). Even though AMD has repeatedly postponed the release of this series, Greymon55 (a reliable source with AMD leaks) was able to extract information from AMD. This information has led him to believe that the processor series will be released in 2022. "Chagall" is the codename for this CPU. The introduction of Chagall next year could indicate that AMD will be employing the Zen3+ microarchitecture rather than the Zen3 microarchitecture, but that remains to be seen.

Context and practical interest

Ryzen 5000 desktop processors deliver powerful gaming, creative and design performance to customers craving performance, either for competitive gaming or creative work tasks, or both.

However, some professionals typically want more cores and performance and if they are willing to stretch their budgets, the Ryzen Threadripper processors are the answer. AMD Ryzen Threadripper processors are the world's most advanced desktop PC processors.



AMD Ryzen Threadrippers are a line of workhorse computer processors, built to perform at the highest level for the toughest jobs, such as animation, video effects, and video game development and design. They are built for serious computer professionals who put their workstations through the toughest jobs a computer can do.

Although these processors are very powerful, they aren't the first option anyone should consider for only gaming or other lighter tasks. That is because the impressive capabilities Threadrippers have come from the number of cores they have and not from those cores' individual specifications. In fact, it is impossible to create a CPU with dozens of cores that are each individually as fast as cores come. Every added core will also add heat and power consumption. To keep a CPU that has a large number of cores from overheating, those cores need to be slowed down a little.

A processor with fewer cores, like the non-threadripper Ryzens, can have faster cores. But a well-built CPU with dozens of cores, like the Threadripper, cannot have quite as fast a clock speed.

Even though each individual core is slightly slower than what's possible, a Threadripper has so many cores, it achieves an outstanding rate of work overall, for the vast majority of even the most extreme computing tasks except gaming. Why? In general, games don't utilize multi cores as well as they could. A lot of the work that could be spread across multiple cores, is done by the GPU, instead of the CPU. The extra cores of a Threadripper CPU can't participate when most of the responsibility is falling to the GPU instead.

A lot of games even still focus on single core performance, instead of using multiple cores. Though this is changing. Multiple cores are becoming a tool for game developers more and more as technology improves. But right now, the general recommendation for a gaming computer is six cores, maybe eight. This will maximize gaming performance. Some recommendations for gaming CPUs go as high as 12 or 16 cores, but even that number is very low compared to the 64 cores the Threadripper has. Maybe someday in the future, those 64 cores will improve gaming performance, but in 2021, game developers just aren't putting that many cores to use, and the Threadripper ends up with 58 cores (or at least 48) going to waste when all you want to do is gaming. But if someone needs a CPU that can handle gaming plus other tasks, like streaming or editing videos or game development (if gaming is not the only priority) a Threadripper is a great option as its numerous cores will enable them to have various processor-hungry tasks running simultaneously.¹

Technological description

Technical Specifications

Lithography: 7nm	Number of cores: 64	Zen 3 based Core architecture
Version PCI Express: PCIe 4.0	Number of threads: 128	Total Cache L3: 256 MB
Memory: 4-channel DDR4 3200MHz	TDP: 280W	

Figure 1 - Chagall leaked specifications

The Ryzen 5000 Threadripper series supports quad-channel DDR4 3200 RAM and ECC² memory, providing server- and workstation-level memory speed and performance. The processor can bear up to 280 W TDPs³ and 64 PCIe 4.0 lanes. It also has a combined cache of up to 256 MB, providing fast access to large data sets.

¹ (Gamin, 2021)

² Error checking and correction (Error-Correcting Code)

³ TDP = Thermal Design Power : the power consumption under the maximum theoretical load

The Ryzen Threadripper 5000 should still be compatible with sTRX4 motherboards on TRX40 chipsets, but a new BIOS update will be required. Motherboard manufacturers are expected to be releasing the necessary BIOS right before launch.

One of the major changes for the Ryzen Threadripper 5000 series will be the Zen 3 core architecture. The CPUs will offer higher clock speeds, rearranged cache (L3), and will feature a slightly refined 7nm process node from TSMC⁴ to offer better overall efficiency.

There are rumors that reasons for the threadripper launch delay could be linked to the adoption of 3D Vertical-Cache, a technology that allows the chip to carry up to 3 times more L3 cache. This would mean that the Threadripper series would go directly from Zen 2 to Zen 3+ architecture.

Monstertruck		
Codename	Chagall	Castle Peak
Process	TSMC N7	
Model	Ryzen Threadripper 5000	Ryzen Threadripper 3000
uarch	Zen 3	Zen 2
Core/Threads	64C / 128T	
L2 Cache	512KB/c	
L3 Cache	4MB/c, 32MB/CCX	4MB/c, 16MB/CCX
Memory	4-channel DDR4 3200	
IO	48+8+8x PCIe 4.0	
Socket	TRX4 (SP3r3)	
Report date: 2021/07/10. Charts by MoePC.net		

Figure 2 - Chagall vs Castle Peak Specifications

Zen 2 vs Zen 3 core architecture

Zen 3 is based on the same 7nm process as Zen 2, meaning that this isn't a generational improvement that only comes from cramming more transistors onto a chip. Instead, AMD made a few improvements to the architecture. Zen 3 is expected to be the last microarchitecture before AMD switches to DDR5 memory and new sockets.

Branch prediction

One of those improvements is **branch prediction**, which helps the CPU predict which instructions it will have to execute next before requests from other parts of the system arrive. This feature is responsible for a large amount of the overall performance of modern CPUs. AMD's new branch predictor not only had more bandwidth, but it can also recover from misses more quickly. This

⁴ TSMC = Taiwan Semiconductor Manufacturing Company. TSMC has been the world's dedicated semiconductor foundry since 1987.

means that the CPU can more easily write itself when the branch predictor makes an incorrect prediction.

Cache

The other big change there was made between Zen 2 and Zen 3 is to the **cache**. The CPU cache is a small amount of very high-speed memory that's built into the CPU die⁵ and is intended to contain the data that the CPU needs to process very fast. Zen 2 had 4 CPU cores accessing a shared 16 MB L3 (level 3) cache, while Zen 3 doubles those numbers with each CCX (core complex) having up to 8 cores, sharing 32 MB of cache. This makes both *core to core* and *core to cache* communication more efficient. Having all the cores together eliminates communication penalties of leaving one group of cores to go to the other. So, in each core complex the 8 cores can talk to each other directly and communicate to the 32 MB of cache directly. This shows the synchronicity of the new design which **lowers the latency** a lot as well. In terms of performance, Zen 3 has an instructions per clock increase of 19% over the previous generation and is able to reach higher clock speeds.⁶

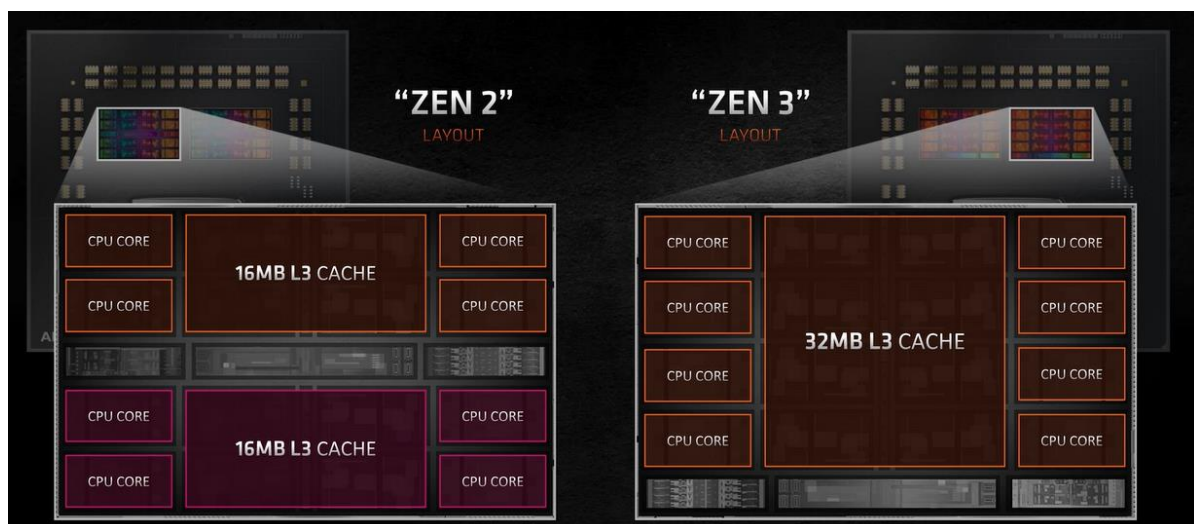


Figure 3 - Zen2 vs Zen3 microarchitecture

AMD Ryzen Threadripper 5000 vs Intel Sapphire Rapids-X HEDT

The Intel Sapphire Rapids-X seem to already support the next DDR RAM and next generation PCIe, but The AMD Ryzen Threadrippers series definitely seems to have the upper hand with more PCIe lanes, smaller transistor sizes, more cores and cache and a higher TDP. AMD has been on top when it comes to the launch of HEDT CPUs and workstation CPUs. The threadripper 5000 series' launch was

⁵ Processor die is a single continuous piece of semiconductor material (usually silicon). A die can contain any number of cores. Processor die is where the transistors making up the CPU actually reside.

⁶ (Techquickie, 2021)

delayed for a while but 2022 seems to be a big year for AMD with many impressive launches including the 3D Zen 3 architecture and launches around the Zen 4 architecture and DDR5.

CPU Family	Intel Sapphire Rapids-X	AMD Ryzen Threadripper 5000
Process Node	10nm ESF	7nm
Core Architecture	Golden Cove	Zen 3
Platform	W790	TRX40/TRX80
Socket	LGA 4677?	LGA 4096
Max Cores / Threads	56/112?	64/128
Max Cache (L3)	168 MB?	224 MB + V-Cache?
Memory Support	DDR5-4800	DDR4-3200
Max PCIe Lanes	64 PCIe Gen 5.0	128 PCIe Gen 4.0
TDP	Up To 225W	Up To 280W

Figure 4 - Intel Sapphire Rapids-X vs AMD Ryze Threadripper 5000

Conclusion

Combined, the AMD Ryzen 5000 Series, Threadripper, and Threadripper PRO processors offer an unbeatable number of options, ideal for anyone at every level and use-case. From aspiring content creators with a passion for gaming to engineers with complex compute operation demands, there is a processor for everyone. AMD Ryzen 5000 has got it all.⁷

⁷ (AMD)

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