Advancement In Processor's Architecture

Avinash Maurya[1], Prachi Mishra[2], Prateek Choudhary[3], Prashant Upadhyay[4]
[1,2,3,4] *Student of Information Technology, RKGIT, Ghaziabad, India*

Abstract **- AMD has launched its next-gen Zen 3 lineup CPU which makes it the best and most powerful commercial CPU series.**
The "Zen 3" core architecture delivers a 19% increase in the instructions per clock for the Ryzen 5600x, 5800x, 5900x, and 5950x.
This is a significant modification in the last decade that happened due to the improvement in core architecture, which results in full access of the L3 cache without having to deal with the extra latency involved.

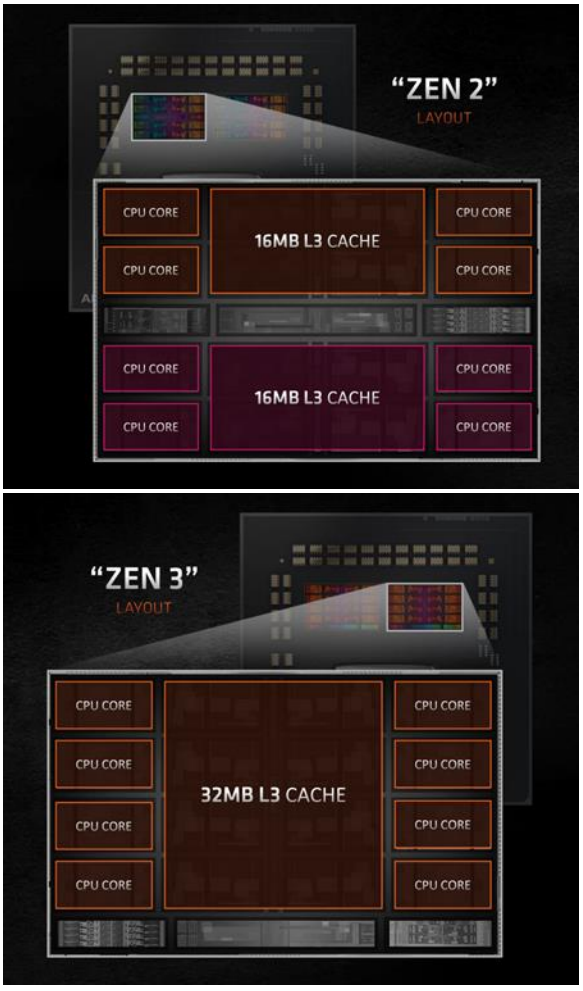
I.INTRODUCTION

In the world of computer performance, there is competition between Intel and AMD processors and both are having a large consumer base, which makes it tricky to get unbiased advice about the best choice for a processor. But in many cases, the answer is very clear. In fact, for most users, it's a blowout win in AMD's favor. As when the launch of the AMD Ryzen 5000 series takes place then the Ryzen processor starts capturing the market at a very large scale and beat Intel in every field such as gaming, application performance, power consumption, and thermals.
Apart from this AMD's newest processors, the Ryzen 9 5950X and Ryzen 9 5900X give an extra boost to PC. Whereas Intel launches its Rocket Lake processors, and they certainly put pressure on the Ryzen 5000 lineup. Rocket Lake brings a 10%-20% IPC(Instructions per cycle) improvement and high clock speeds that stretch up to 5.3 GHz with the flagship Core i9-11900K which pushes the chip to its limits and the chips still come on the aging 14nm processor.
Index Terms- Intel, AMD, Ryzen 5000 series, CPU

II. AMD'S ARCHITECTURAL IMPLEMENTATION

Zen3 architecture contains a large series of performance improvements over Zen2 architecture, the major difference between Zen2 and Zen3 is from a physical layout perspective. The Zen2 AMD Ryzen processor series had a big improvement in architecture as they moved from 12/14nm processors to 7nm architecture manufactured by TSMC (Taiwan Semiconductor Manufacturing Company).
The 2nd Gen AMD Ryzen processor's which is there in the AMD Ryzen 7 3700x has one compute die with 8 cores and one input/output die that handles PCI express lanes, SATA, USB, etc. Here, the layout of die matters. In the Zen2 layouts, the L3 cache that is of 32MB lies in the middle, which is separated into 2 parts of 16MB each with 4 cores on either side so, in total, we get 32 MB of L3 cache with 8 total CPU cores.
If we look at the gen 3 architecture it's a little bit different, we've got 32 MB of L3 cache just like the Zen2 but, here is the big difference in how the cores are laid out. You have still the same cores but they're all together.
Making them fast individual CPU core for responsive computing, the designs in Zen 3 helps to have all of those cores together eliminate some communication penalties of leaving one group to go to the other, it also has the practical effect of doubling the cache and every core has access to it directly so on zen2 each group of 4 has direct access to 16 Mb, but on zen3 there is direct access to 32 MB, so put together you got all cores that talk to one another directly and you got 32MB of cache to which every core has direct access.
So that's a lot more synchronicity and lower latency in the design and that is the design goal, the zen3 architecture has delivered a significant bump in gaming and computing performance.
All the 8 cores are in one single large block. The major difference in CPU with Zen2 is when you want to talk to the other group of 4 cores you have to leave the CPU I/O die, Similar is the case when you consider going back and forth between the 4 cores. The same happens when the cache too. The division can be seen in the chip diagram the CCD(Core chiplet die) is kind of cut in half, dividing it into two parts, you get 16MB with

4 cores on one side and 16 MB with 4 cores on the other side. This is great for scalability because it allows AMD to join both groups of 4 together to make much larger blocks. And that's how we get 16 cores in socket AM4 or 64 core with Threadripper designs with awesome scalability.



III. MARKET COMPETITORS

Intel is one of the industry's leading market competitors for AMD. With each product launch there is a consumer shift between competitors.

Before the AMD 3000 series, AMD was known for its budget and entry-level segment, but with the launch of the Ryzen 3000 and Ryzen 5000 series, AMD has set a new benchmark for the consumer computing market. While the new CPU's are still valued for money, the new pricing scheme has set 5000 series lineups at power with Intel's 11th Gen Rocket Lake Processors. They certainly put pressure on the Ryzen 5000 lineup. Rocket Lake brings a 19% IPC improvement and high clock speeds that go up to 5.3 GHz with the flagship Core i9-11900K, but the chips still come with the aging 14nm processors.

These new chips max out at eight cores as opposed to the ten cores found with Intel's previous-gen chips. Unexpectedly, the Willow Cove architecture's high IPC gains helped Intel shrink the performance gap with AMD, and in some cases win in important price brackets.

Intel also has its Alder Lake chips launching later this year, which will completely redefine x86 desktop PC chips with a new hybrid architecture. Not to be upstaged, AMD has its new CPU's with 3D V-Cache headed to production later this year. AMD's chips will bump up to 15% more gaming performance due to an almost-astonishing 192MB of L3 cache paired with a Zen 3 processor.

When Intel and AMD are compared ion the basis of specifications, it's seen that AMD more cache a robust PCIe 4.0 and a processor with more number of cores and threads, and also a long time support of their processors for their motherboards unlike Intel.

As Intel gives support and compatibility for only two generation of processors and their motherboards.

Due to this reason AMD becomes a sensible choice for people who want to upgrade their rigs with time.

AMD has a capable Ryzen processor that offers more value than comparable Intel models. Conversely, Intel now is losing the budget segment.

IV. CONCLUSION

Intel still has innumerable customers that don't use a discrete GPU, especially in the high-volume OEM market. Intel's Rocket Lake processors helped shore up its defenses in the mid-range, but AMD's Ryzen 5000 series has changed the paradigm entirely, and Rocket Lake can't convincingly defeat AMD's fastest processors.

AMD wins the CPU war overall currently, but an Intel processor could still be the better choice depending on one's needs. Intel has the advantage if you want the best in overclocking or software support, or if you want productivity performance without buying a discrete GPU. But, if you want the best balance of performance and price in the Intel vs AMD lineup, or just the fastest performance possible, but within a power-efficient package, AMD is the smart choice.

The result of all the design changes AMD has made with the Zen3 architecture results in 19% average performance uplift over a variety of all SPEC workloads, with a median figure of 21%. That is indeed a tremendous achievement, because the new Ryzen 5000 series chips run slightly higher clock than their predecessors, further amplifying the total performance increase of the new design.

REFERENCES

[1] https://www.geeksforgeeks.org/difference-between-intel-and-amd/
[2] https://www.amd.com/en/corporate/innovations
[3] https://youtu.be/5sAcXhad16k
[4] https://www.amd.com/en/corporate/innovations
[5] https://www.amd.com/en/technologies/zen-core-3
[6] https://www.pcmag.com/opinions/in-desktop-cpus-amd-is-doing-these-5-things-better-than-intel
[7] https://www.digitaltrends.com/computing/amd-vs-intel/
[8] https://www.tomshardware.com/features/amd-vs-intel-cpus